soil health matters:
DESIGN FOR WHAT YOU DON'T HAVE

Natural Resources Conservation Service

August 2013

To build soil health, start by looking for what's missing.

"You read the signs of poor soil health, and design a crop and livestock system that will give you what you don't have in your current operation," says Jay Fuhrer, a district conservationist with the Natural Resources Conservation Service in Bismarck, North Dakota.

"The principles of building healthy soils are the same everywhere—you have to stop tilling the soil and switch from a monoculture crop to a diversity of crops and rotations," Fuhrer says. "But the path to soil health is different on each farm. Cover crop and cash crop selections and sequences are chosen to fit the farmer's resource concerns and priorities, and the means available at that farm."

As you look for what's missing on the farm or ranch, you often find it's a combination of things, Fuhrer says. Common findings are low levels of organic matter, poor nutrient cycling and poor water infiltration. Soil compaction, poor soil structure, and little "armor" or protection of the soil at the surface are other issues.

Different systems for different farms

Fuhrer has been studying, observing, practicing and recommending soil health measures for 20 years. He's helped numerous Burleigh County farmers and ranchers establish complete systems. But the specifics of each plan, and fields within the plans, are different.

"Local farmers Gabe and Paul Brown wanted better nutrient cycling and higher levels of organic matter, and they wanted a really diverse mixture of crops along with integrating their cattle into the cropping system," Fuhrer says. "They bumped their organic matter levels from as low as 1.7 percent to as high as 5.0 percent by rotating more than 50 different crops and cover crops in a series of cocktail mixes at Brown's Ranch."

For Marlyn and Patrick Richter, who also farm in Burleigh County, it was a matter of looking for early harvested crops that would offer a window for seeding cover crops, then selecting from crop types that had not often been grown on the farm. They turned to turnips and radishes to scavenge nitrogen from sandy soils with high nitrogen leaching potential and used millet and sudan to give their soils some protective armor.

"Farmers not familiar with how mixtures of cover crops work together ask 'why would I want to plant a cover crop that uses up all my water?'" Fuhrer says. "A test on the Richter Farms during a dry spring answered that question for me. It found their diverse annual cropping rotations and cover crop combinations increased their soil organic matter by 1 percent, which resulted in a 25 percent increase in water holding capacity and up to 30 pounds an acre more of useable nitrogen. Their cover crops used water to grow, but they improved the soil structure by

Jay's Soil Health Keys

The keys to farming or ranching systems that build soil health are:

1. Minimize soil disturbance.
2. Provide soil armor (cover).
3. Always have live roots growing in the soil.
4. Use diverse plants, rotations and (where possible) animals.

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building soil aggregates, providing armor for the soil surface, and recharging the water in the soil profile."

Yet another approach was taken at Black Leg Ranch, where major goals were to improve nutrient cycling and to integrate livestock, as well as to create food and shelter habitat for wildlife. Cover crops were left standing until after hunting season, and strip-grazed by the cow herd over the winter.

Misconceptions about multiple species

Fuhrer says that's one of the values of planting a cover crop after harvest is its ability to continue the capture of sunlight energy via the photosynthesis process and ultimately transform that sunlight into additional carbon in the soil. "Most farmers don't have enough crop types in their operations," he says. "They're used to shutting off the photosynthesis process after a monoculture crop is harvested in the fall. We've found most farmers won't try cover crops—especially mixes of multiple species—until they understand what the mix will do for them."

Having grown up on a small grain and livestock farm before he started his conservation career, Fuhrer knows the misconceptions well.

"I used to think multiple crops would compete with each other, but I've learned they help each other grow if you follow the model of native rangeland diversity," he says. "You get some benefits from using two or three cover crops together, but the benefits are exponential with the synergy you create to feed the soil biology with a dozen species together."

Fuhrer says first-time cover crop users tend to use only one or two species because they think that's simplest. "I think using one or two species is a step in the right direction, but using 10 or 12 species can actually accelerate biological time."

A multiple-species planting is actually easier and safer to manage than a single species cover crop, Fuhrer maintains.

Cover crop cocktail mixes with primarily cool season species.

"The more diversity you have, the more plant balance you have above ground, and with that plant balance comes a more balanced soil biology below ground," he says.

That point will come through very clearly in a drought, Fuhrer says. "Monocultures struggle in a drought, but we've watched six-to-eight-species cocktail mixes flourish in dry times. And as an added bonus, those mixtures work together to crowd out weeds."

The Soil Health Demonstration Farm

The five supervisors of the Burleigh County Soil Conservation District felt so strongly about promoting soil health that they borrowed money to purchase a 150-acre cropland farm in 2009. Called the Menoken Farm, its goal is to improve soil health with sustainable cropping systems, cover crop, livestock integration and organic inputs such as compost.

They've grazed cattle in the late fall and sheep in the summer by strip-grazing the cover crop mixtures. By mimicking the diversity of native rangeland, the farm

Cover crop cocktail mixes with primarily warm season species.

has become home to numerous species of native pollinators and birds.

For his part, Fuhrer says he's often felt he wasted the first half of his conservation career. "I wasn't thinking about soil health in 1980. Where too much water was running off the land, my answer was to put in a waterway. It was a band aid practice; the real issue was we couldn't get the water into the soil profile," he says. "I knew there was something I was missing. I just didn't know what it was."

Now, Fuhrer knows the key to conservation is to restore diversity in the landscape and with it, soil health.

"We're giving the soil its life back. That's what I was missing," Fuhrer says. "I could retire now, but I'm having too much fun."

Soil Health Team Makes a Difference

Jay Fuhrer says the seeds of Burleigh County's soil health transformation were sown in the early 1990s, when a soil health team was formed. The idea really took root, he says, when all five of the soil conservation district supervisors converted to no-till on their operations. Then, in 2006, the stage was set for great gains with the introduction of "cocktail" combination cover crops, the switch from 3-4 pasture rotation systems to 25-30 pasture systems, and the integration of livestock into cropping and cover crop systems.

"We decided 20 years ago we needed a change," Fuhrer says. "We all agreed we could no longer accept a degrading soil resource. We wanted our soil to do much more than simply hold up a growing plant. We came together and began educating ourselves on soil health, one issue at a time. We'd look at how to build organic matter, then how to eliminate soil compaction, and how to get the soil to hold more water. No-till expert Dwayne Beck and soil biology expert Kris Nichols are on our team, and we call on others. What a difference the team has made," Fuhrer says.

Fuhrer recalls the team's first soil health tour, when only four people showed up to ride the trailer to demonstration fields.

"Our latest tour was attended by 150 people asking lots of questions," Fuhrer says. He estimates 70 percent of the county's farmers use 100 percent no-till, and another 20 percent are direct seeding with knife openers. Only 10 percent still farm with traditional tillage methods.

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